Water Management Resources:

Analysis and comparison of modeling groundwater storage using in-situ measured data and GRACE satellite estimates to enhance water management practices in the Rio San Juan Watershed

By:

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Opening Scene: Appear
Video of satellite orbiting the Earth (obtained from http://svs.gsfc.nasa.gov/search/Keyword/HDTV.html). Quickly fades to black.

Scene #2: Appear
NASA logo appears (obtained from http://team3926.org/images/NASA_logo.png). Quickly fades to black.

Scene #3: Cross fade
DEVELOP Summer 2012 logo appears (obtained from https://docs.google.com/open?id=1BabmaxHi9AcHoF-Ts8_VhnQjUrH65Sm7rJQNDrn819jhcwmGrjIH8Sfmzckc) with background music (Decisions, No author synths, Percussion from http://incompetech.com/m/c/royalty-free/index.html?keywords=decisions&Search=Search) repeating all the video. Fades to black

Scene #4: Fade In black
Remote sensing video (obtained from http://svs.gsfc.nasa.gov/search/Keyword/HDTV.html) with text "Water Management in the Rio San Juan Watershed" appears in blue text. Underneath the title are the locations: "Wise County, VA, USA & Saltillo, Mexico" in black text. Fades to black.

Alejandro (voice over)

"One of the most vital resources for us is water; it is a major natural resource that we need in order to survive."

Scene #5: Fade In black
Photo of the Water Manegement team. Fade in black
Video of GRACE orbiting the Earth (obtained from http://svs.gsfc.nasa.gov/vis/a010000/a010400/a010480/index.html). Swap
Marte R. Gomez reservoir photos (obtained from http://www.usda.gov/wps/portal/usda/usdahome). Cross fade

Carlos (voice over)

"The NASA DEVELOP Mexico Water Management Team, constructed of two teams located in Wise County, USA, and Saltillo, Mexico, utilized remote sensing to determine total groundwater storage in the Rio San Juan Watershed by analysis and comparison of modeling groundwater storage using in-situ measured data and GRACE satellite estimates."

Scene #6: Cross fade
Image of the Bravo Hydrologic region. (obtained from http://commons.wikimedia.org/wiki/File:Riogranderivermap.png?uselang=es) path to San Juan river Fade in black.

Image of irrigation. (obtained from Tecnologico de Monterrey) Fades to black.

Image of agriculture (obtained from www.fao.org/ag/magazine/0603sp1.htm)

Image of San Juan river in Camargo Tamaulipas (obtained from http://mw2.google.com/mw-panoramio/photos/medium/28717598.jpg). Cross fade

Carlos (voice over)

"The Rio San Juan watershed, covering 34,000km^2, is a major tributary in the Mexico portion of the Rio Bravo Hydrologic Region. The majority of the water used in this region is used for agriculture and users self-report how much water is used. This has caused a concern for water shortage in the area. The increasing water demand for domestic, industrial, and agricultural usage has stressed the current supply and severe droughts continue to exhaust the region's known reserves. "

Scene #7: Cross fade

Interview with Armando Alonso Rodriguez, Assistant Manager of Operational Technical Assistance at CONAGUA – Coahuila. Subtitles are provided at the bottom of the screen in white text. Fade to black.

Armando Alonso Rodriguez (subtitles):

"And that is why CONAGUA needs to know how much water a region requires and also how much water is exploited or extracted to create restriction policies for water exploitation when the extraction, demand, or water usage is exceeded or is close to the available volume of water."

Scene #8: Cross fade

Water image with "The Results" text sliding in from the Left.
Fades to next scene.

Scene #9: Cross fade

Presentation slide: "Change in Total Water Storage using GRACE". Interchange
Kaitlyn (Voice Over)

"For this project we calculated the change in total water storage by using the GRACE satellite data. Once our data was obtained, we processed each file into ArcMap 10 and clipped the data to our study region to obtain monthly values of total water storage."

Scene #10: Interchange

Presentation slide: "Change in Total Water Storage". Interchange
Vanessa (Voice Over)

"To ensure that GRACE was adequately measing total water storage in the region, the GRACE estimate was compared with an independent water balance equation. The water balance equation measures total water storage by calculating the difference between water entering the basin in the form of precipitation and water leaving the basin in the form of evapotranspiration and river discharge. This graph shows the total water storage anomaly estimated by GRACE, as well as the total water storage calculated using the water balance equation with in-situ and TRMM precipitation datasets from January 2002 to October 2010. We found that the total water storage fluctuations are fairly similar, with the exception of the spike noticed in November 2003

from our in-situ measurements. Good agreement between GRACE and the water balance equation allows for GRACE satellite data to be used to calculate the change in groundwater storage for this region."

Scene #11: Interchange
Presentation slide of Calculating Groundwater Storage. Interchange
Aida (voice over)

"Once we had our change in total water storage, we then calculated the total groundwater storage using a simple equation. For this calculation, we compared GRACE data with TRMM precipitation data, in-situ measurements, and soil moisture data from the GLDAS NOAH 1 model. Our soil moisture data, like the GRACE data, was processed in ArcMap 10 and clipped to the study area. As you can see, only eight pixels cover our study area. To determine which results would be the most accurate, both eight and four pixel values were used for data analysis."

Scene #12: Interchange
Presentation slide of Groundwater Anomalies. Interchange
Paul (voice over)

"It was determined that the groundwater storage calculations were sensitive to the soil moisture data. The eight pixel soil moisture data represented an increase in total water storage when the four pixel data showed a decrease in total water storage. Along with this, our in-situ data was showing a decrease in total water storage as well. This could be due to the limitations in spatial resolution from the GRACE satellite and the soil moisture data from the GLDAS NOAH 1 model. Both data sets are processed in a one degree format whereas TRMM data was processed in 0.25 degree format."

Scene #13: Interchange
Presentation Slide of Change in Groundwater Storage using Eight Pixels. Interchange
Idalina (voice over)

"This graph represents groundwater storage using the eight pixel soil moisture data. The eight pixels that were used in this calculation are shown on the right outlined in red. As you can see in the graph, with eight pixels of soil moisture, the GRACE satellite shows an increase in total change in groundwater storage whereas our TRMM and in-situ measurements were showing a decrease in storage. Because of the differences in spatial resolution, we observed four pixels of soil moisture instead."

Scene #14: Interchange
Presentation slide of Change in Groundwater Storage using Four Pixels. Cross fade
Kaitlyn (voice over)

"When we used only four pixels of soil moisture with the groundwater storage calculations, we determined that there was a better agreement between GRACE, TRMM, and the in-situ data gathered. The four pixels that we used for this calculation is shown on the left outlined in red. In conclusion, we have determined that overall; we are seeing a depletion in groundwater storage in our area. In future work, we plan to validate our GRACE calculations with in-situ groundwater measurements. Our final results will be transferred to our project partners to provide a better understanding on how to utilize remote sensing and in-situ measurements to determine groundwater fluctuations. This knowledge can influence policy making in our study region and water management practices worldwide."

Scene #15: Cross fade

Team image of San Juan river processed in Arc scene 10

References

--NASA. Goddard Space Flight Center
http://svs.gsfc.nasa.gov/search/Keyword/HDTV.html

--MParors. NASA logo.
http://team3926.org/images/NASA_logo.png

--NASA. GRACE Beauty Pass Animations
http://svs.gsfc.nasa.gov/vis/a010000/a010400/a010480/index.html

--USDA. Marte R. Gomez. http://www.usda.gov/wps/portal/usda/usdahome

--Kmusser. Elevation data from SRTM, drainage basin from GTOPO, U.S. stream from the National Atlas.
http://commons.wikimedia.org/wiki/File:Riogranderivermap.png?uselang=es

--Tecnologico de Monterrey

--Agriculture and Consumer Protection Department. What's water worth?
www.fao.org/ag/magazine/0603sp1.htm

--Luishu. Panoramio.
http://mw2.google.com/mw-panoramio/photos/medium/28717598.jpg

--Wired Science. Change in Mexican Irrigation Can Be Seen From Space.
http://www.wired.com/wiredscience/2010/10/mexican-irrigation-seen-from-space/

--Background music: Decisions, no author. Synths, Percussion. Royalty free.

Scene #16: Fade In black

Changing irrigation in Mexico Landsat satellite images (obtained from http://www.wired.com/wiredscience/2010/10/mexican-irrigation-seen-from-space/)

Acknowledgements sliding up.

Idalina (voice over)

"We would like to acknowledge the following:"

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Jack Kennedy
Wise County Court House Staff

Scene #17: Fade in black

Video of the rotating Earth with a view of Space. (obtained from http://svs.gsfc.nasa.gov/search/Keyword/HDTV.html)

Idalina (voice over)

"For more information on DEVELOP, visit our website at develop.L-A-R-C.nasa.gov."